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Caprella kuroshio, a new species (Crustacea: Amphipoda: Caprellidae), with a redescription of *Caprella cicur* Mayer, 1903, and an evaluation of the genus *Metacaprella* Mayer, 1903

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Abstract.—A new species of *Caprella, C. kuroshio,* is described based on the specimens collected from the Pacific coast of central Japan. *Caprella cicur* Mayer, 1903, closely related to the new species, is redescribed based on the type material. The new species differs from *C. cicur* in the shape of the pereonites and the second gnathopod. The female of the new species has a pair of abdominal appendages, which is a diagnostic character of the genus *Metacaprella* Mayer, 1903. However, the abdominal appendage is considered to be a polymorphic and symplesiomorphic character in *Caprella* and *Metacaprella.* Therefore, the genus *Metacaprella* is not recognised, and the new species is assigned to the genus *Caprella.*

In 1991, during a study of the caprellid fauna of the west coast of Shikoku, western Japan, numerous specimens of a caprellid species were collected by the author from the red algae, *Gelidium elegans* Kützing, at Kashiwajima Island, Kochi Prefecture. Afterward, many individuals of the same species also were found on *G. elegans* in Kushimoto and Shirahama, Wakayama Prefecture, in 1992 and 1996 respectively. Furthermore, a single specimen of the species was collected from the drifting brown algae, *Sargassum* sp., in Suruga Bay in 1993. Detailed examination revealed that all of these specimens belong to a new species. The description of the species is presented here.

The type series is deposited in the Seto Marine Biological Laboratory, Kyoto University (SMBL).

Caprella kuroshio, new species
Figs. 1–5

Type material.—Holotype (SMBL Type No. 391): male, 26 Apr 1991, on *Gelidium elegans,* 2 m in depth, Sankaku-bae, Kashiwajima Island (32°46′N, 132°38′E), Kochi Prefecture, Japan. Paratypes (SMBL Type No. 392): 10 males, 10 females, collected together with holotype.

Additional material examined.—10 males, 10 females, 4 Jun 1992, on *Gelidium elegans,* 1 m in depth, Sabiura, Kushimoto (33°28′N, 135°46′E), Wakayama Prefecture, Japan; 1 male, 10 Apr 1993, on drifting *Sargassum* sp., off the mouth of Fuji River, Suruga Bay (35°04′N, 138°39′E), Shizuoka Prefecture, Japan; 5 males, 5 females, 16 Jun 1996, on *Gelidium elegans,* depth unrecorded, Rinkai, Shirahama (33°42′N, 135°21′E), Wakayama Prefecture, Japan.

Description of holotype.—Body (Fig. 1A) 9.65 mm long, smooth. Head with blunt triangular projection directed straight forward; pereonite 1 shorter than head; pereonite 2 longer than pereonite 3, with single acute projection on ventral surface between insertions of second gnathopods (Fig. 1B).

Antenna 1 (Fig. 1A) longer than a half of the body length; flagellum consisting of 14 segments, shorter than peduncle. Antenna 2 (Fig. 1A) shorter than peduncle of antenna 1; peduncular segments 3–5 with 2

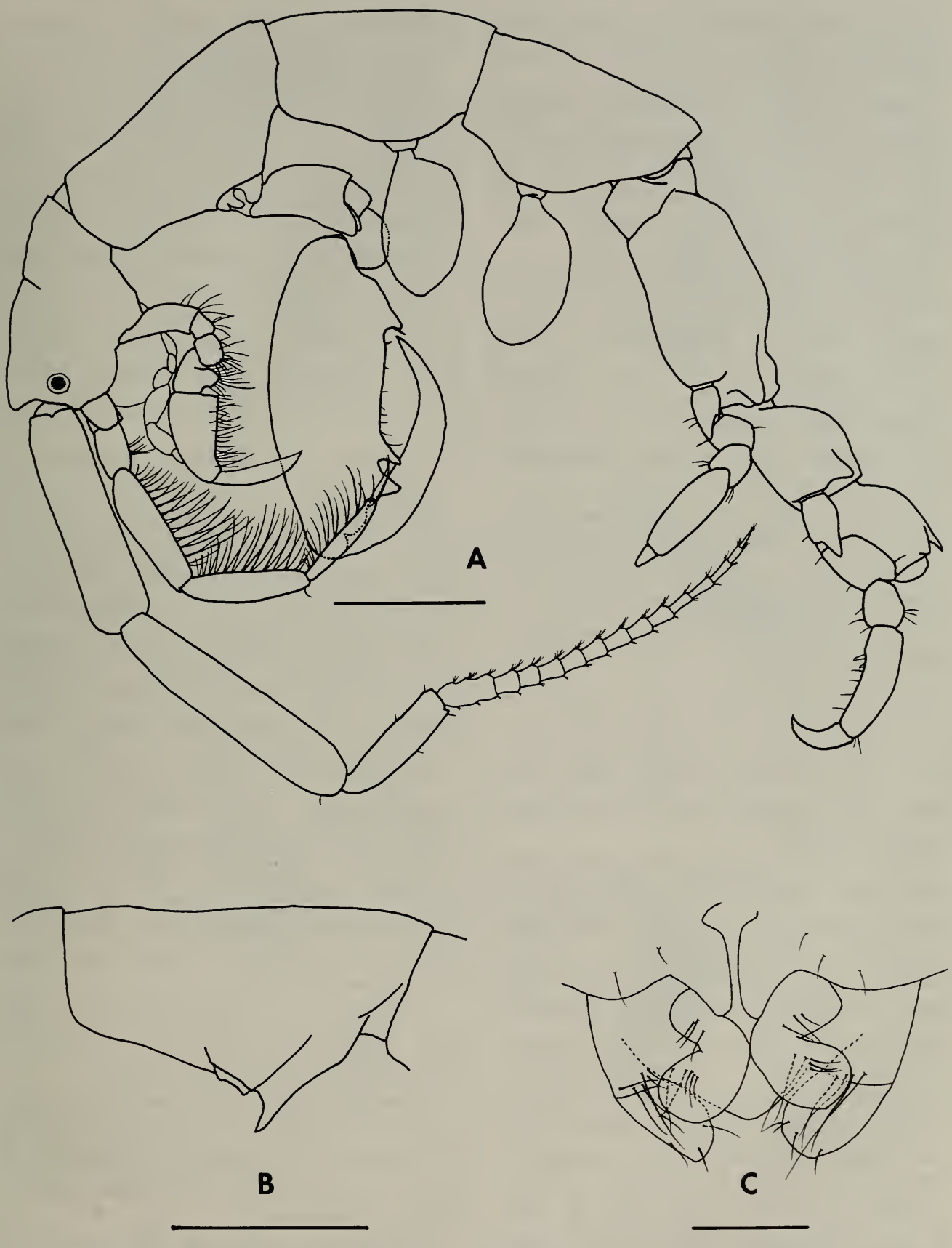

Fig. 1. *Caprella kuroshio,* new species, holotypic male: A, body, lateral view; B, pereonite 2, lateral view; C, abdomen. Scales: A, B = 1.0 mm; C = 0.1 mm.

rows of dense long setae on ventral surfaces; flagellar segment 1 with 2 rows of dense long setae on ventral surface.

Upper lip (Fig. 2A) semicircular, slightly concave on apical margin, densely pubescent. Inner and outer lobes of lower lip (Fig. 2B) well-developed, round, densely pubescent on apicomedial margins; mandibular process developed.

Mandible (Fig. 2C–D) without palp. Left and right sides consisting of 5- and 4-toothed incisor, 5- and 6-toothed lacinia mobilis, and setal row of 3 and 2 plumose setae respectively. Molar process well-developed, with 1 plumose seta; left molar with triangular stout projection; right molar with pubescent molar extension.

Maxilla 1 (Fig. 2E) without inner lobe. Its outer lobe rectangular, with 3 simple and 4 serrate spines on apical margin. Palp 2-segmented. Its distal segment bearing a row of teeth and 6 spines on apical margin, 7 setae on inner margin, 2 rows of setae on ventral surface.

Inner lobe of maxilla 2 (Fig. 2F) shorter than outer lobe, oval, with 2 rows of numerous setae on apicomedial margin. The outer lobe rectangular, with 2 rows of setae on apical margin.

Inner lobe of maxilliped (Fig. 3A) small, with 3 short spines on apical margin, and numerous marginal setae. Outer lobe small, subequal to palpal segment 1 in length, bearing 1 long stout seta on apex, 7 short spines on medial margin, and numerous marginal setae. Palp 4-segmented; segment 1 short; segments 1–2 bearing numerous long setae on medial margins, and segment 3 on apicomedial surface; segment 4 falcate, longer than apical setae on segment 3, with rows of setulae on grasping margin.

Gnathopod 1 (Fig. 3B) robust. Its ischium and merus short, with setae on ventral surfaces. Carpus expanded ventrally, bearing numerous setae. Propodus bearing rows of setae on medial surface. Palm bearing a pair of grasping spines at the proximal corner, its grasping margin straight and minutely serrate, bearing rows of setae. Dactylus falcate, bearing rows of numerous teeth on grasping margin.

Gnathopod 2 (Figs. 1A, 3C) attached to midpoint of pereonite 2. Basis shorter than pereonite 2 in length, bearing laterodistal and mediodistal triangular projections. Ischium bearing lateral triangular projection. Propodus oblong, two times longer than basis. Palmar corner produced, bearing single large grasping spine on apex. Palmar margin slightly concave, bearing a pair of small grasping spines on proximal end, subdistal poison tooth, and distal triangular projection. Dactylus curved and narrowed distally.

Gills (Fig. 1A) present on pereonites 3–4, large, oval.

Pereopods 5–7 (Figs. 4A–C) morphologically similar, but increasing in size posteriorly. Basis bearing triangular dorsal projection at posterior end. Merus inflated dorsally. Propodus longest; palm bearing a pair of grasping spines on proximal corner, and rows of short setae on slightly concave grasping margin. Dactylus bearing minute serration on curved grasping margin.

Abdomen (Fig. 1C) consisting of a pair of appendages, a pair of lateral lobes, and single dorsal lobe. Abdominal appendage 2-segmented; three setae present on both proximal and distal segments; tip of distal segment round. Lateral lobes bearing 6–7 proximal and 4–5 distal setae. Penes large, situated medially.

Description of paratypic female.—Body (Fig. 5A–B) 6.90 mm long. Pereonite 2 subequal to pereonite 3 in length.

Antenna 1 (Fig. 5A) subequal to a half of the body length. Flagellum consisting of 13 segments, subequal to peduncle in length. Antenna 2 (Fig. 5A) longer than peduncle of antenna 1.

Gnathopod 2 (Figs. 5A, C) attached to anterior end of pereonite 2. Propodus oval. Palmar margin slightly convex, bearing subdistal small poison tooth and distal triangular projection. Dactylus slightly curved.

Abdomen (Fig. 5D) consisting of a pair

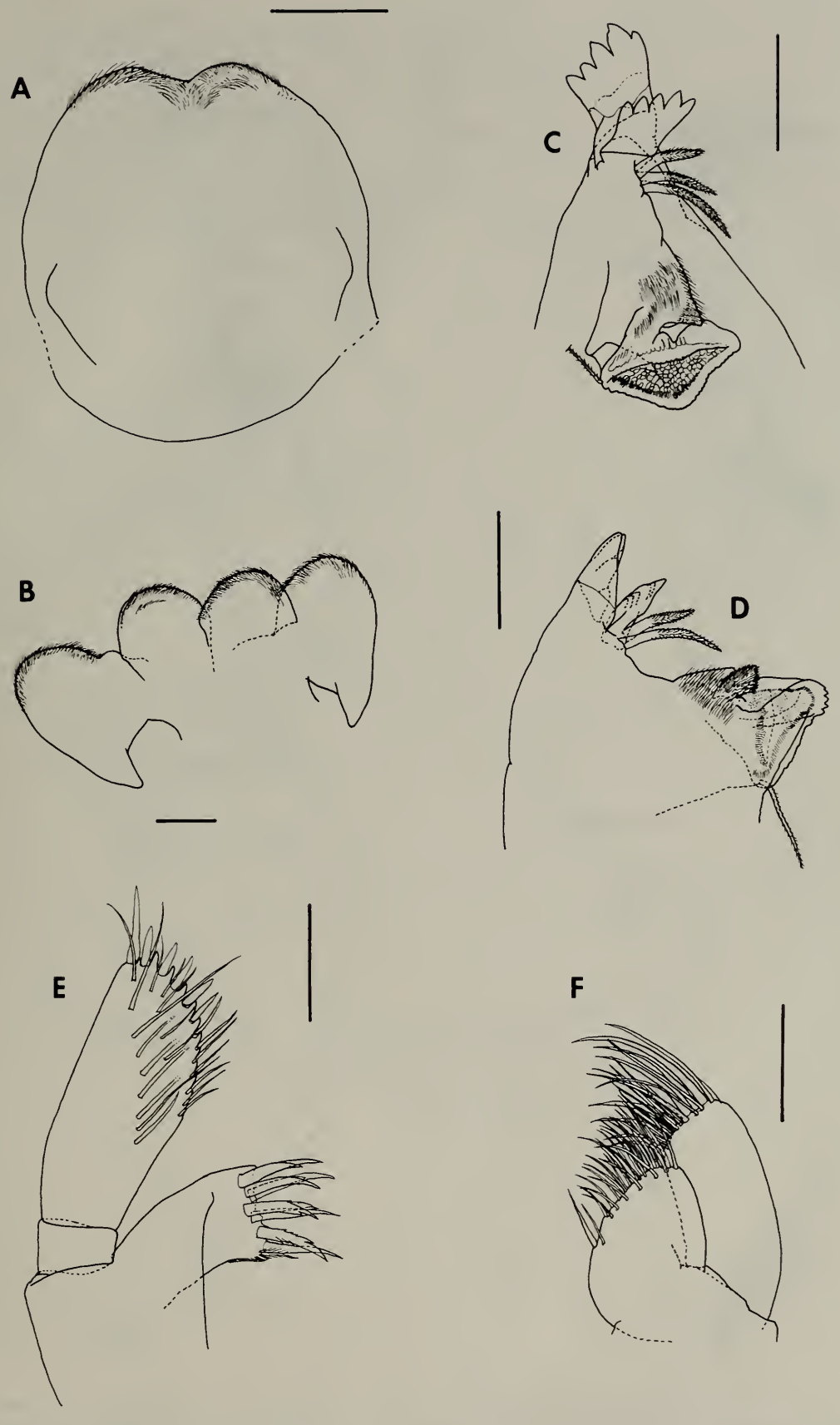

Fig. 2. *Caprella kuroshio,* new species, holotypic male: A, upper lip; B; lower lip; C, left mandible; D, right mandible; E, maxilla 1; F, maxilla 2. Scales: 0.1 mm.

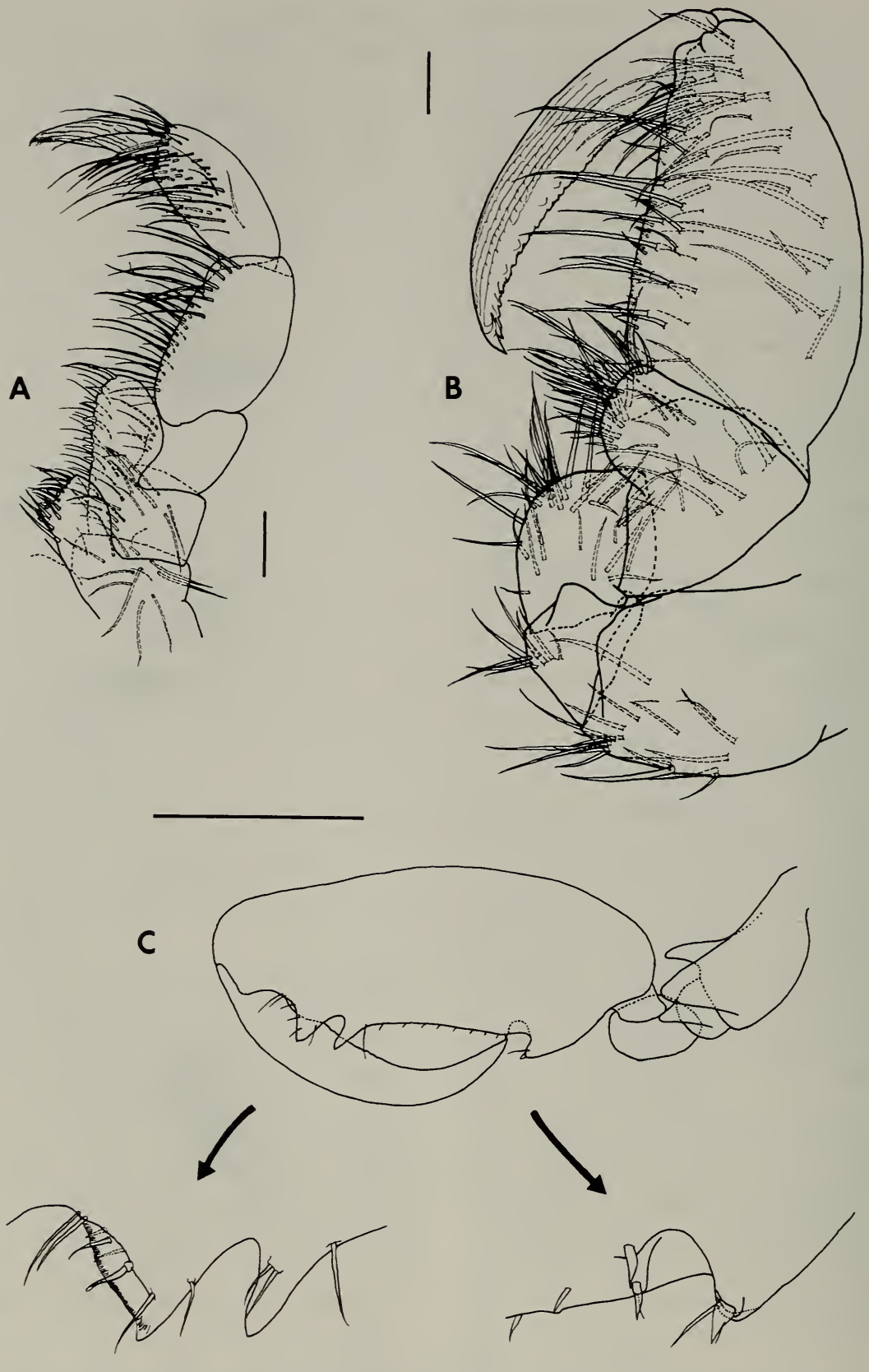

Fig. 3. *Caprella kuroshio,* new species, holotypic male: A, maxilliped; B, gnathopod 1; C, gnathopod 2 with details of palmar projections indicated by arrows. Scales: A, B = 0.1 mm; C = 1.0 mm.

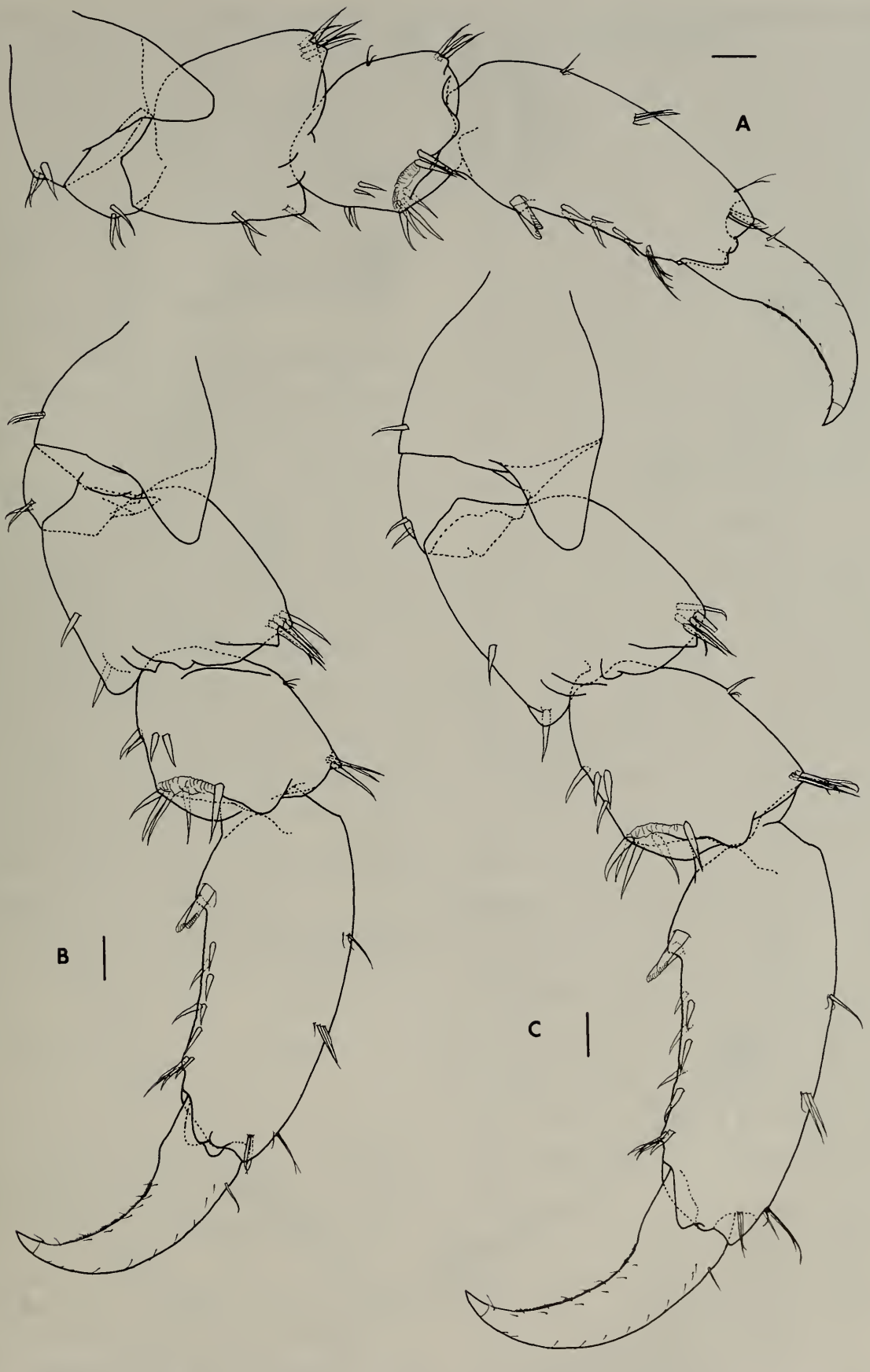

Fig. 4. *Caprella kuroshio,* new species, holotypic male: A, pereopod 5; B, pereopod 6; C, pereopod 7. Scales: 0.1 mm.

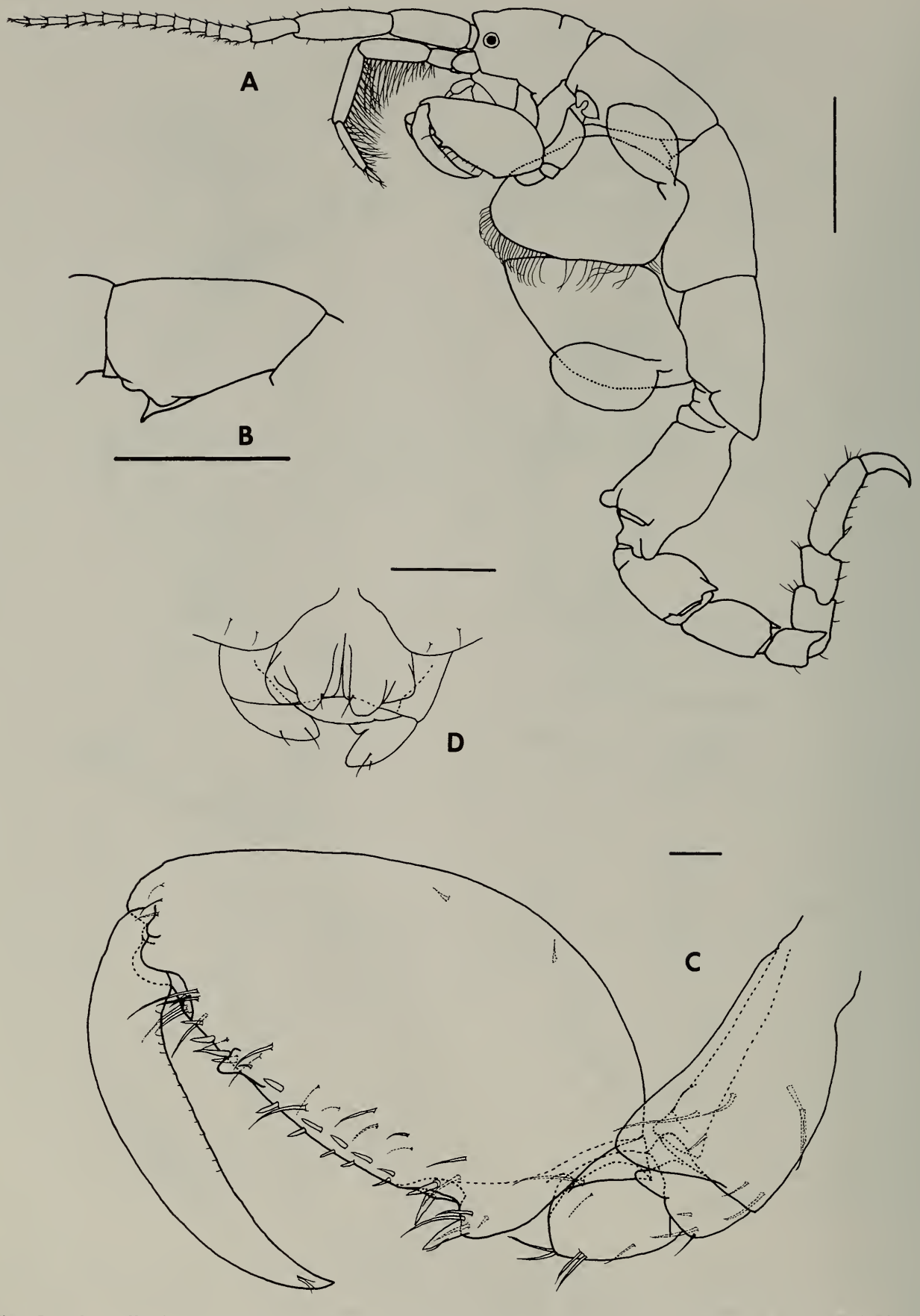

Fig. 5. *Caprella kuroshio,* new species, female: A, body, lateral view; B, pereonite 2, lateral view; C, gnathopod 2; D, abdomen. Scales: A, B = 1.0 mm; C, D = 0.1 mm.

of appendages, a pair of lateral lobes, and single dorsal lobe. Abdominal appendage unsegmented, small, bearing 1 subterminal seta. Lateral lobe with 2 distal setae.

Color in life.—Specimens occurring on the red algae *Gelidium elegans* are scarlet to wine red. A single male collected from the drifting *Sargassum* sp. in Suruga Bay is yellowish.

Etymology.—The specific name is from the Kuroshio current.

Remarks.—*Caprella kuroshio* resembles *Caprella penantis* Leach, 1814 in general appearance. However, the former is distinguishable from the latter by: pereonite 2 with ventral projection; male antenna 1 longer than half the body length; basis of male gnathopod 2 with mediodistal triangular projection; palmar margin of male gnathopod 2 with subdistal poison tooth; female abdomen bearing a pair of appendages.

Caprella kuroshio is also similar to *Caprella cicur* Mayer, 1903, an endemic species to South African waters (Griffiths 1974a, 1974b, 1975, 1976). The species has never been redescribed in detail since Mayer's original description. Here, *C. cicur* is redescribed below using the type material and compared to *C. kuroshio.*

The type series has been deposited in the South African Museum, Cape Town (SAM).

Caprella cicur Mayer, 1903
Figs. 6–10

Caprella cicur Mayer, 1903:75, 97, pl. 4 (figs. 5–7), pl. 8 (figs. 3–5); Griffiths, 1974a:255; Griffiths, 1974b:331; Griffiths, 1975:174; Griffiths, 1976:86, 104.

Material examined.—Syntypes (labeled as "Cotypes"): 1 male, 1 female (SAM 1312), Table Bay, Cape Town, on *Palinurus lalandi,* collected by W. F. Purcell, June 1897.

Description of male.—Body (Fig. 6A) 10.40 mm long. Head with small, acute triangular projection directed straight forward; pereonite 1 longer than head; pereonite 2 longer than pereonite 3, with acute ventral projections between insertions of second gnathopods, and acute lateral projection on insertion of second gnathopod; pereonites 3–4 with ventrolateral small projections on anterior end; pereonite 5 with dorsolateral small projections and lateral blunt knobs on anterior end; pereonite 6 with a pair of dorsal minute projections.

Antenna 1 (Fig. 6A) longer than a half of the body length; flagellum consisting of 14 segments, shorter than peduncle. Antenna 2 (Fig. 6A) shorter than peduncle of antenna 1; peduncular segments 3–5 with 2 rows of dense long setae on ventral surfaces; flagellar segment 1 with 2 rows of dense long setae on ventral surface.

Upper lip (Fig. 7A) semicircular, slightly concave on apical margin, densely pubescent. Inner and outer lobes of lower lip (Fig. 7B) well-developed, round, densely pubescent on apicomedial margins; outer lobe with an apicolateral incomplete fold; mandibular process developed.

Mandible (Figs. 7C–D) without palp. Its left and right sides consisting of 5-toothed incisor, 5-toothed and irregularly-toothed lacinia mobilis, and setal row of 3 and 2 plumose setae respectively. Molar process well-developed, with 1 plumose seta, and triangular stout projection.

Maxilla 1 (Fig. 8A) without inner lobe. Its outer lobe rectangular, with 7 bifid spines on apical margin. Palp 2-segmented. Its distal segment bearing a row of teeth and 8 spines on apical margin, 4 setae on inner margin, rows of setae on ventral surface.

Inner lobe of maxilla 2 (Fig. 8B) shorter than outer lobe, oval, with 2 rows of numerous setae on apicomedial margin. The outer lobe rectangular, with 2 rows of numerous setae on apical margin.

Maxilliped removed.

Gnathopod 1 (Fig. 8C) robust. Its ischium short. Ventral margin of merus produced anteriorly, bearing numerous setae on anteroventral surface. Carpus expanded ventrally, bearing numerous setae. Propo-

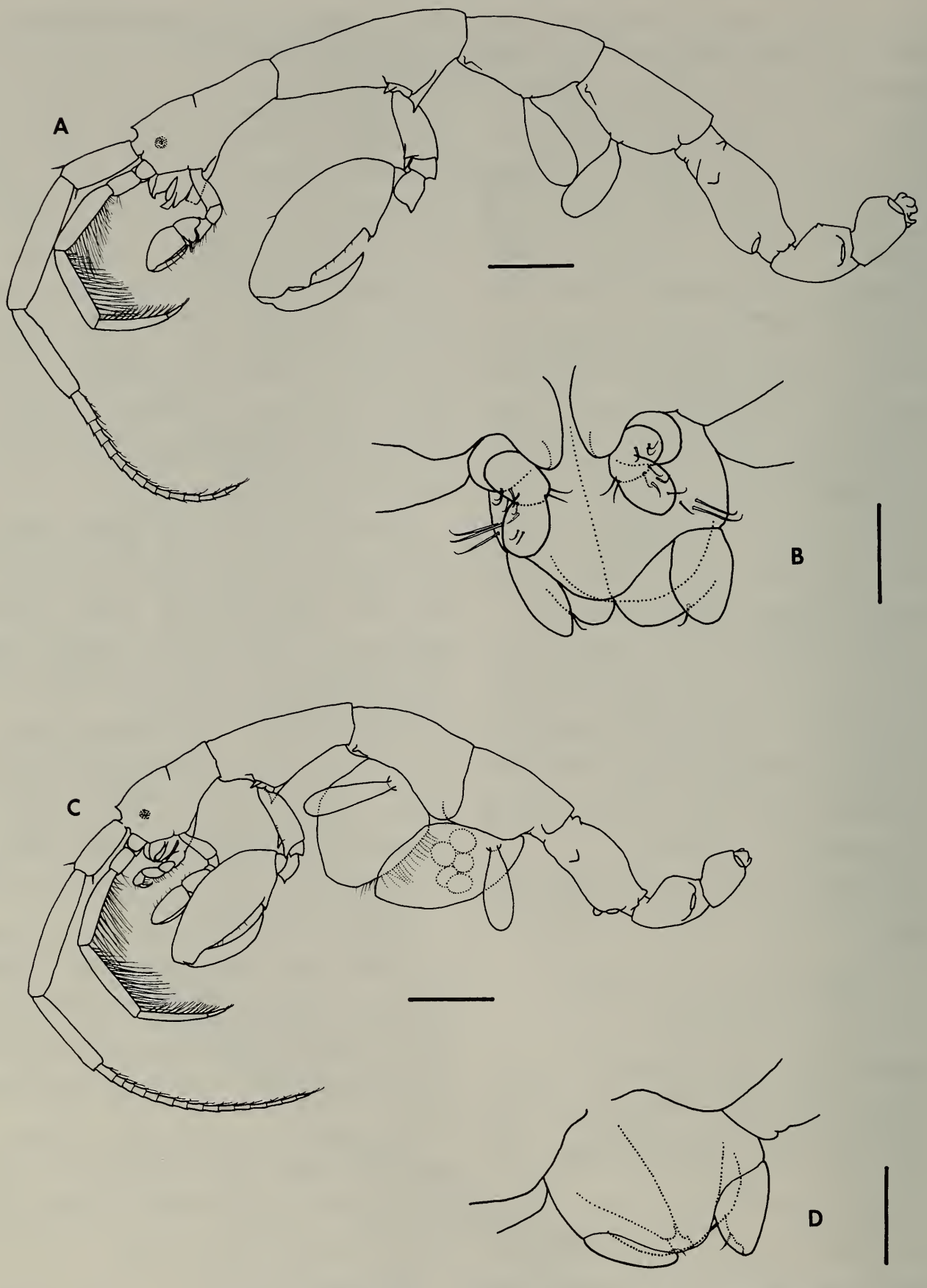

Fig. 6. *Caprella cicur* Mayer, 1903, syntypes: A, male, lateral view; B, male abdomen, ventral view; C, female, lateral view; D, female abdomen, ventral view. Scales: A, C = 1.0 mm; B, D = 0.1 mm.

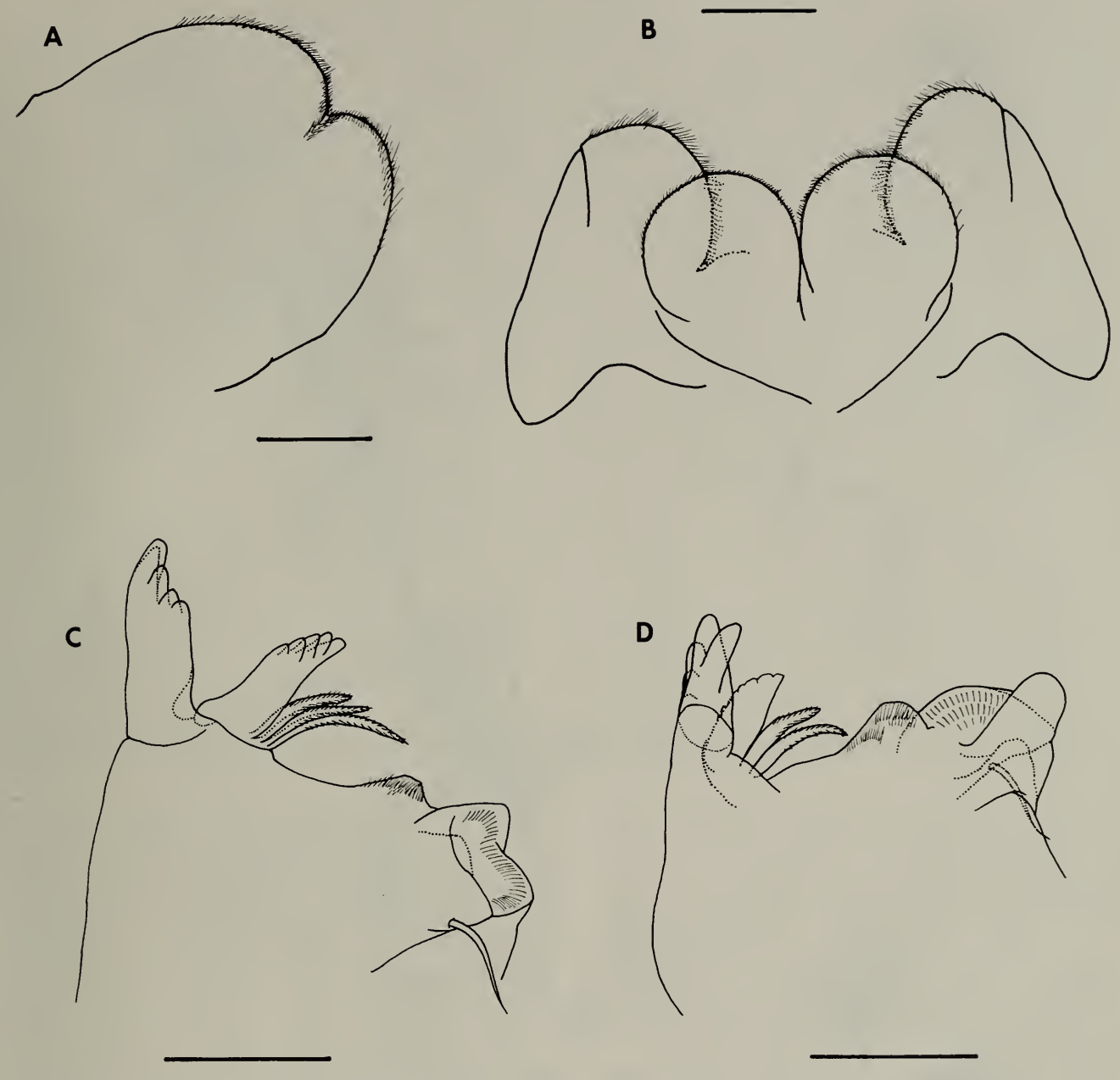

Fig. 7. *Caprella cicur* Mayer, 1903, syntypic male: A, upper lip; B, lower lip; C, left mandible; D, right mandible. Scales: 0.1 mm.

dus bearing rows of setae on medial surface. Palm bearing a pair of grasping spines at the proximal corner, its grasping margin straight, bearing rows of setae. Dactylus falcate.

Gnathopod 2 (Fig. 6A) attached to pereonite 2 posteriorly. Basis shorter than pereonite 2 in length, bearing laterodistal and mediodistal triangular projections. Ischium bearing lateral triangular projection. Merus acutely produced anteroventrally. Propodus oblong, 2.5 times longer than basis. Palmar corner produced, bearing single large grasping spine on apex. Palmar margin without poison tooth, with distal triangular projection. Dactylus curved and narrowed distally.

Gills (Fig. 6A) present on pereonites 3–4, large, elliptical.

Pereopods 5–7 fell off.

Abdomen (Fig. 6B) consisting of a pair of appendages, a pair of lateral lobes, and single dorsal lobe. Abdominal appendage 2-segmented, bearing 10 setae; tip of distal segment round. Lateral lobe bearing 4 proximal and 1 distal setae. Penes large, situated medially.

Description of female.—Body (Fig. 6C)

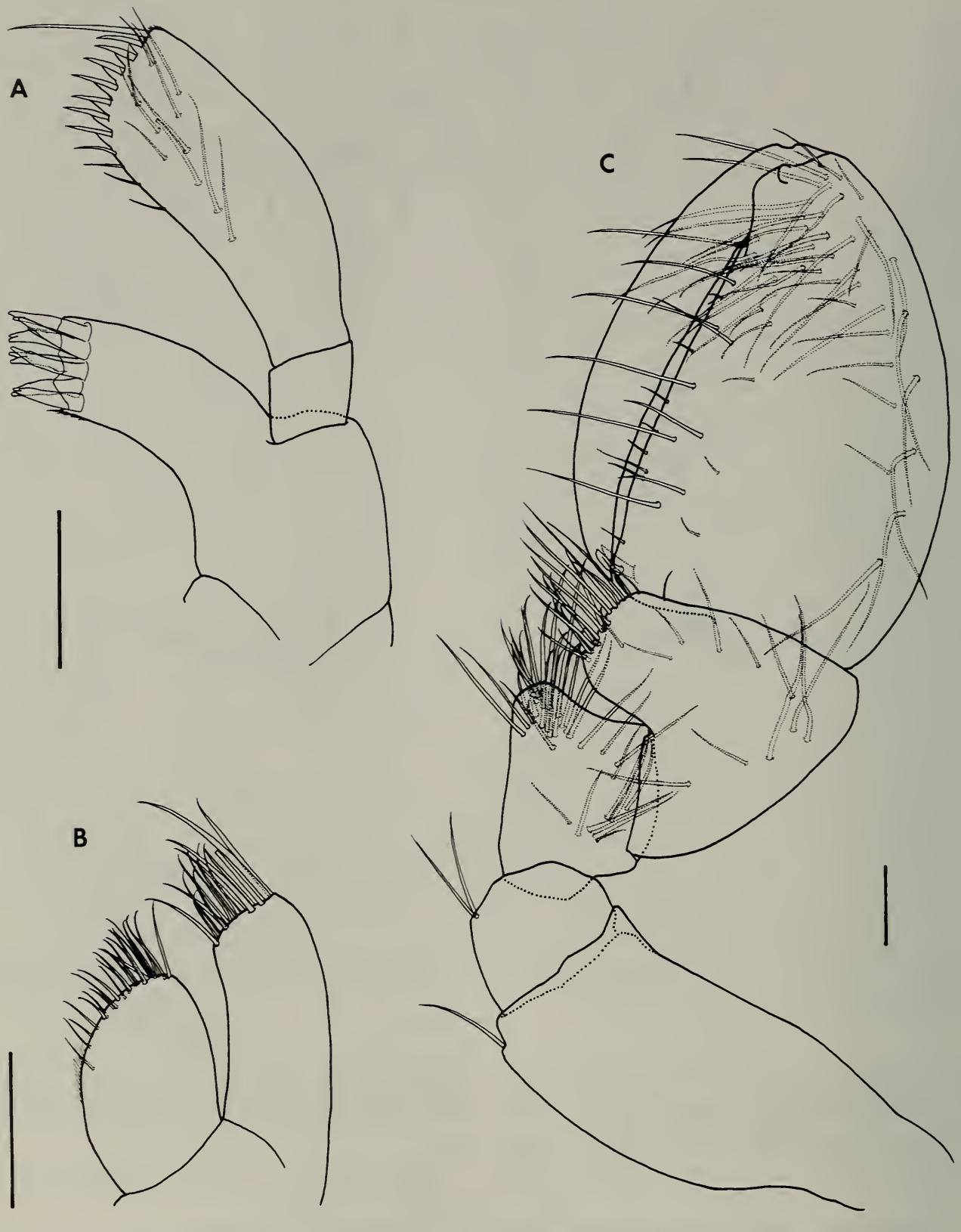

Fig. 8. *Caprella cicur* Mayer, 1903, syntypic male: A, maxilla 1; B, maxilla 2; C, gnathopod 1. Scales: 0.1 mm.

8.40 mm long. Pereonite 1 slightly shorter than head; pereonite 2 slightly longer than pereonite 3; pereonite 4 without ventrolateral small projections on anterior end; pereonite 6 without dorsal projections.

Antenna 1 (Fig. 6C) longer than a half of the body length. Flagellum consisting of 15 segments, slightly shorter than peduncle. Antenna 2 (Fig. 6C) slightly longer than peduncle of antenna 1.

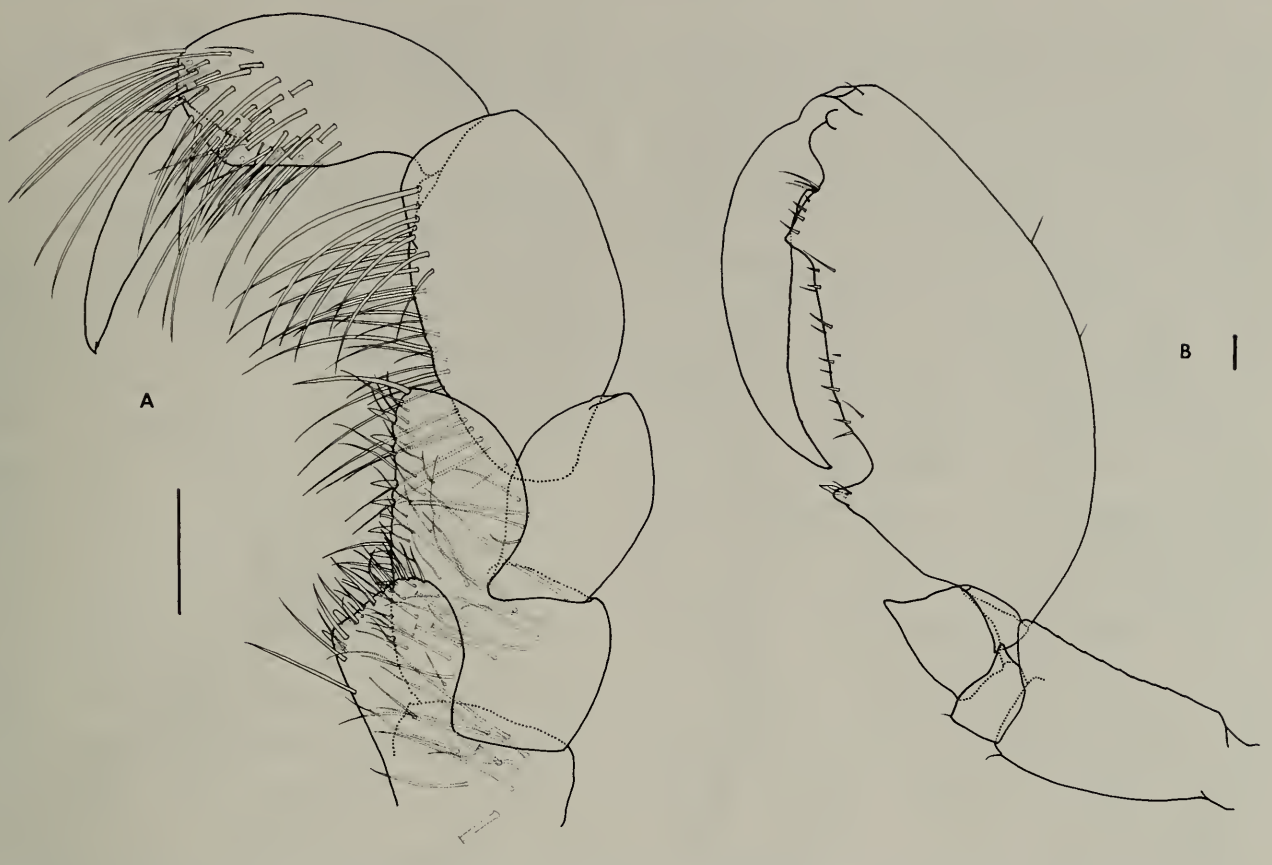

Fig. 9. *Caprella cicur* Mayer, 1903, syntypic female: A, maxilliped; B, gnathopod 2. Scales: 0.1 mm.

Inner lobe of maxilliped (Fig. 9A) small, with 2 short spines on apical margin, and numerous marginal setae. Outer lobe small, subequal to palpal segment 1 in length, bearing 1 long stout seta on apex, 8 short spines on medial margin, and numerous marginal setae. Palp 4-segmented; segment 1 short; segment 2 bearing numerous long setae on medial margin, and segment 3 on apicomedial surface; segment 4 falcate, longer than apical setae on segment 3.

Gnathopod 2 (Figs. 6C, 9B) attached to pereonite 2 anteriorly. Propodus oval. Palmar margin slightly convex. Dactylus slightly curved.

Abdomen (Fig. 6D) consisting of a pair of lateral lobes and single dorsal lobe, without appendages.

Pereopods 5–7 (Fig. 10) morphologically similar. Basis bearing triangular dorsal projection at posterior end. Merus inflated dorsally. Palm of propodus bearing a pair of grasping spines on proximal corner, and rows of short setae on slightly concave grasping margin. (Pereopods 5–7 were detached from the pereonites, and scattered in the vial. Therefore, it is indeterminable to which specimen, and to which pereonite, each pereopod was attached.)

Remarks.—Caprella kuroshio is distinguishable from *C. cicur* by: pereonites 1–2 not elongate; pereonites 5–6 without dorsal projections; pereonites 3–5 without lateral projections; insertion of gnathopod 2 without lateral projection; palmar margin of gnathopod 2 with poison tooth; female abdomen bearing a pair of appendages.

Discussion

The most remarkable feature of the new species is the presence of paired abdominal appendages in the female. If the generic diagnosis of Mayer (1903) had been adopted, this species would be assigned to the genus *Metacaprella* Mayer, 1903. However, *Metacaprella* has been considered a questionable genus among the Caprellidea, because it was established only on the basis of the presence of the abdominal appendages in

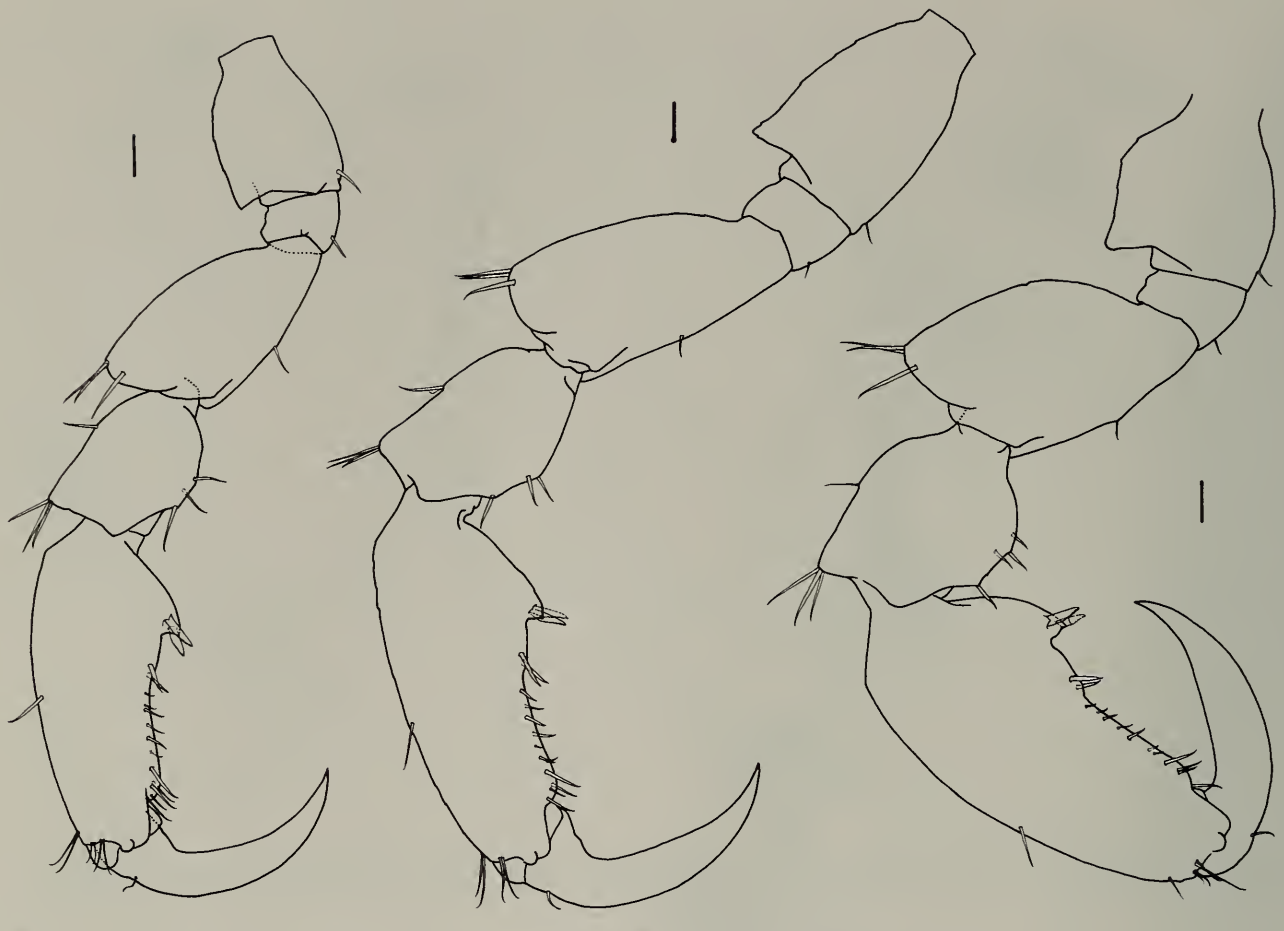

Fig. 10. *Caprella cicur* Mayer, 1903, pereopods 5–7 of syntypes. Scales: 0.1 mm.

the female (Laubitz 1970). In this section, I assess the taxonomic value of the abdominal appendages based on a survey of the literature to determine whether the genus *Metacaprella* is a valid taxon or not.

History of Metacaprella.—Mayer (1903) suggested the possibility of splitting the genus *Caprella,* and tentatively proposed the genus *Metacaprella* for *Caprella anomala* Mayer, 1903 and *Caprella kennerlyi* Stimpson, 1864, based on the presence of paired abdominal appendages in the female. At that time, however, he hesitated separating the two species from *Caprella.* Subsequently, Dougherty & Steinberg (1953) adopted Mayer's generic distinction. They included the two species to *Metacaprella,* and designated *M. kennerlyi* as the type species of the genus. They also referred *Caprella ferrea* Mayer, 1903 to *Metacaprella* provisionally because of its general resemblance to *M. kennerlyi* and *M. anomala,* even though no females of *C. ferrea* had been found at that time.

In the catalog of the world caprellids, McCain & Steinberg (1970) listed these three species in the genus *Metacaprella.* McCain (1968) and Laubitz (1970) criticized Mayer's generic distinction on the basis of unreliable characters such as the organization of the abdomen. Laubitz (1970) stated, "Thus the separation of *Metacaprella* from *Caprella,* solely on the basis of the female abdomen, is highly unsatisfactory." However, she inconsistently retained the genus *Metacaprella* consisting of *M. anomala* and *M. kennerlyi.* She restored *M. ferrea* to *Caprella,* because there was no sign of the presence of appendages on the female abdomen of the species. Laubitz (1972) transferred *Caprella horrida* G. O. Sars, 1877 to *Metacaprella* based on the presence of a pair of small appendages on the female abdomen. Subsequent authors

also have allowed the genus *Metacaprella* to stand in their caprellid faunal studies (Vassilenko 1974, Arimoto 1976, Martin 1977).

Ontogeny of the abdominal appendages.—Sakaguchi (1989) described the postmarsupial development of *Caprella scaura diceros* Mayer, 1890, reared in the laboratory. All the hatchlings (body length 1.25 mm, flagellum of antenna 1 2-segmented, sexes still indistinct) had paired abdominal appendages bearing a single apical seta (Fig. 11A). In males, the appendage was still 1-segmented and small in the specimen with 5-segmented flagellum of antenna 1 (body length 2.62 mm), but became larger and 2-segmented in the older specimens (Figs. 11B–E). In contrast, the appendages of the female had been reduced in the specimen in the early stage (body length 2.66 mm, flagellum of antenna 1 5-segmented), and only their apical seta was left as a vestigial structure (Figs. 11F–H).

Takeuchi (1989) also thoroughly described the postmarsupial development of *Caprella danilevskii* Czerniavski, 1868, *C. okadai* Arimoto, 1930, and *C. generosa* Arimoto, 1977, reared in the laboratory. In these three species, all the early juveniles had paired abdominal appendages bearing single apical setae. The appendages grew larger in males, whereas they were reduced in females, as in *C. scaura diceros.*

The postmarsupial development of *Metacaprella* species have not been investigated, except for Mayer's (1903) illustration of the abdomen of a juvenile of *M. kennerlyi.* The abdomen of the juvenile bears a pair of unsegmented small appendages with single apical setae. It should be noticed that the morphological features of the appendage are almost identical to those of the above-mentioned four *Caprella* species.

Intra-generic morphological variations of abdominal appendages.—Consultation of the literature (above) shows that the intra-generic variations for the morphology of abdominal appendages exist in both *Caprella* and *Metacaprella.*

In *Caprella,* the degree of reduction of the female abdominal appendages varies specifically. In *C. okadai* and *C. cristibrachium* Mayer, 1903, the appendages are completely reduced (Takeuchi 1989, Lee & Lee 1993), whereas in *C. generosa,* a pair of setae is present as a vestigial structure (Takeuchi 1989). Furthermore, the intraspecific morphological variation of the abdomen exists in females of *C. danilevskii.* The female from the Japanese waters has only a pair of vestigial setae on the abdomen (Takeuchi 1989), whereas those from the western North Atlantic and the Mediterranean have a pair of small abdominal appendages (McCain 1968, Krapp-Schickel 1993). In the male, on the other hand, the morphology of the abdominal appendages varies specifically. In *C. simia* Mayer, 1903, they are distinctly 2-segmented (Mori & Yamato 1993), whereas in *C. monoceros* Mayer, 1890 and *C. santosrosai* Sánchez-Moyano, Jiménez-Martín, & García-Gómez, 1995, their segmentation is not distinct (Aoki & Kikuchi 1990, Sánchez-Moyano et al. 1995).

In *Metacaprella,* the degree of development of the female abdominal appendages also varies specifically. The female of *M. anomala* has relatively large, incompletely 2-segmented appendages on the abdomen (Mayer 1903, Laubitz 1970). In females of *M. horrida* and *M. kennerlyi,* the appendages are small and unsegmented (Mayer 1903; Laubitz 1970, 1972). The similar morphology also can be seen in the juvenile of *M. kennerlyi* (Mayer 1903).

Concluding remarks.—It is apparent that the morphology of the abdominal appendage changes ontogenetically in the above-mentioned four *Caprella* species (Sakaguchi 1989, Takeuchi 1989). Furthermore, the intrageneric, and even intraspecific, morphological variations of the abdominal appendage exist in *Caprella* and *Metacaprella* species. These facts emphasize that the external morphology of the abdominal appendage is not an ontogenetically and morphologically stable character enough to di-

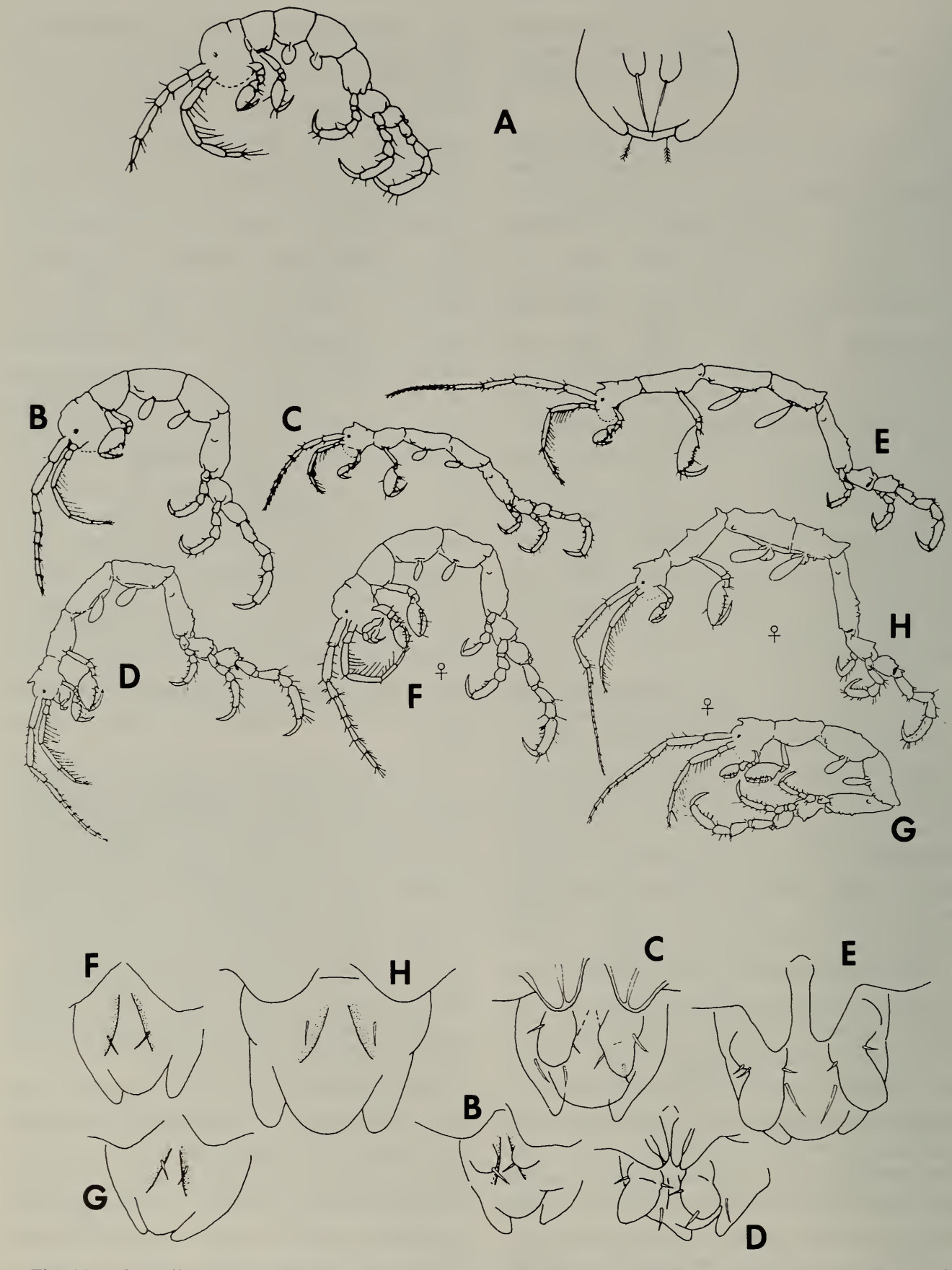

Fig. 11. *Caprella scaura diceros* Mayer, 1890, juveniles, body and abdomen: A, hatchling (body length 1.25 mm); B, male (body length 2.62 mm); C, male (body length 3.75 mm); D, male (body length 5.40 mm); E, male (body length 8.86 mm); F, female (body length 2.66 mm); G, female (body length 5.28 mm); H, female (body length 9.11 mm) (modified from Sakaguchi, 1989).

agnose a genus, and its taxonomic value seems to be relatively low.

In the Caprellidea, the loss and reduction of characters are considered to be apomorphic (Larsen 1997). The ontogenetic information confirms that the reduction of abdominal appendages is an apomorphic character state in the genus *Caprella.* Morphological features of the juvenile abdomens of the four *Caprella* species are almost identical to that of *M. kennerlyi.* Female abdominal appendages are present in early developmental stages of both genera. They are reduced to various degree in later juvenile stages in *Caprella,* while they remain in adults in *Metacaprella.* Because characters appear earlier in the ontogeny are considered to be ancestral and those appear later derived (Eldredge & Cracraft 1980), the presence of the abdominal appendage in the adult female of *Metacaprella* is not an autapomorphy of the genus, but a symplesiomorphy of the species assigned to the genus.

Metacaprella and *Caprella* shares almost all diagnostic characters, and the morphology of female abdominal appendages varies gradually within these two genera, namely, from incompletely 2-segmented (*M. anomala*) through unsegmented (*M. kennerlyi, M. horrida* and Atlantic *C. danilevskii*) or vestigial (*C. generosa* and Japanese *C. danilevskii*) to completely reduced (*C. okadai* and *C. cristibrachium*). No gaps enough to separate *Metacaprella* from *Caprella* could be found. Therefore, the establishment of the genus *Metacaprella* only on the basis of a plesiomorphic character, i.e., abdominal appendage, is considered to be inadequate. Consequently, I decline to adopt the genus *Metacaprella* as a separate taxon, and assign the present new species to the genus *Caprella.*

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